TILLAGE METHODS

FOR

AREAS OF LIGHT RAINFALL

IN

WESTERN CANADA

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WITH THE COMPLIMENTS OF
THE CANADIAN BANK OF COMMERCE

TILLAGE METHODS FOR AREAS OF LIGHT RAINFALL IN WESTERN CANADA

Under present conditions on the dry lands of Western Canada tillage is the greatest means at man's disposal for controlling the factors that cause low yields.

Tillage is the manipulation of the soil by means of implements. In itself it adds nothing to the soil, neither does it take anything away. Yet it may be used, (1) to modify the plant food, water, heat and air content of the soil, (2) to control weed growth, and (3) to facilitate the decay or removal of surface rubbish such as stubble, grass and manure.

Some specific uses to which tillage may be put are:

1—The storing of moisture in the soil, as by plowing deep, early in the rainy season.

2—The conservation of moisture in the soil, as by the granular mulch on the surface resulting from surface cultivation.

3—Facilitating the movement of soil water, as by firming loose soils and loosening hard soils.

4—The modification of soil temperature, as by lessening evaporation and by firming the soil over the seed.

5—Increasing the earliness of a crop, as by packing, storing less moisture and developing less available plant food.

6—Increasing or decreasing the air content, as by loosening hard soils or firming loose soils.

7—The development of available plant food, as by influencing the heat, moisture and air content of the soil.

8—The killing of native grasses and shrubs, e. g., plowing in a dry time.

9—To control weeds, as by surface cultivation, to expose roots and kill them by drying.

10—To control soil drifting, as by the practice of shallow ridging and the use of the GRANULAR mulch.

11—To dispose of rubbish and cause its decay, as by plowing same under.

The implements used in tillage are of three kinds:

1—Plows.
2—Cultivators or soil looseners.
3—Soil firmers.

There are mould board and disc plows and among the mould board types there are sod and stubble plows of many patterns. Each of these may be fitted with coulters, jointers or drag chains, and the coulters may be "rolling" "blade" or "fin." But all are plows. Their chief functions are to cover rubbish, to expose the roots of undesirable plants and to provide a surface that can be prepared satisfactorily for the seed.

TILLAGE METHODS FOR AREAS OF LIGHT RAINFALL

Among cultivators, which include intertilling machines, are those having discs, cutting blades or stirring points. Those having cutting blades may have spring teeth, "duck" feet, or long slanting knives. But all are cultivators, and their chief function is to loosen up the surface soil in order to maintain a mulch or kill weeds or admit air.

Among the implements that firm the soil and thus crush lumps or lessen the air spaces or warm up the land, are: the surface packer, the sub-surface packer, the combination packer, the rollers of various types and the home made planker or scrubber.

All of these are soil firmers or clod crushers of different degrees of efficiency and of vastly different cost. One will fit certain specific soil conditions better than any other. All have a place in the economy of some particular farm and most of them when used intelligently will prove a profitable investment. Yet none is absolutely essential on any farm. The work of firming the soil can be accomplished with other implements though generally not so efficently as with the machines designed for the purpose.

BREAKING PRAIRIE SOD

1—Break early in dry regions

Early breaking provides a receptive soil for the June and July rains thus lessening the run off: but its greatest value results from killing the native vegetation and thus keeping in the soil the enormous amount of water that would otherwise be transferred into the atmosphere by the growing of these plants.

Early breaking stores and conserves more moisture and produces a heavier but rather later crop than breaking done at a later date; it also unfortunately provides better conditions for the roots of the grass plowed under to spring into growth again, hence the greater need for thorough cultivation or for "backsetting" early breaking.

The drier the climate the earlier the breaking should be done; the more moist the climate, the later it may be left.

The following figures show the influence of time of breaking on the yield of 1915 crops at the Saskatchewan Agricultural College:

Broken in ..	June, 1914	July, 1914	Aug., 1914	Sept., 1914	April, 1915
	Bus.	Bus.	Bus.	Bus.	Bus.
Wheat	37	33.6	28.1	23	22.2
Barley	43.2	38.5	33.3	25.2	18.7
Flax	19	16.6	15.1	14.7	13.9

2—Plow all the land and turn the furrow over flat

Good plowing when breaking prairie sod is equally as important as any other phase of the breaking operations. No skips should occur. Poorly plowed breaking does not kill all the grass and the result is in the second and often in subsequent crops this pest increases and seriously lessens the yield. In stubble fields it is one of the chief causes of low yields. It can be largely prevented by thorough plowing.

The furrow slice should be turned over flat on the furrow bottom, otherwise the sod does not rot satisfactorily and the furrow slice itself dries out too much. It has been observed that where good plowing is done and the furrow slice turned down flat, rather than on edge, that the sod rots better and larger returns are secured.

3—Pack after breaking

The furrow slice should be pressed firmly against the subsurface soil in order (1) to hasten the decay of vegetation plowed under; (2) to facilitate the rise of moisture to the seed bed.

For this purpose the land packer or the planker or scrubber gives excellent results. In the dry summer of 1914 the only breaking on which the sod was thoroughly rotted was breaking that had been well firmed down. In a wet season the necessity for packing is not so great.

On low lying soils, the sod of which is composed largely of creeping rooted grasses, it is sometimes advisable to leave the land unpacked for a few days to permit the furrow slice to partly dry out and thus aid in killing the grass.

4—Disc deep breaking as soon as possible after it can be done without turning up sods

Moisture evaporates rapidly from the surface of a firm soil. As soon as discing can be done without turning up unrotted sod, it should be done. On some soils it can be done very soon after breaking, but on others it often has to be left until the sod is at least partially decayed. The sooner it can be done the more moisture it will conserve.

In practice it is generally found advisable to break in the breaking season, and to disc after breaking has become difficult or impossible. This permits of a better distribution of the labor and power and is often economically wise.

5—Cultivate sufficiently during the season to maintain a mulch and to control the growth of native plants

Evaporation and growing plants waste enormous quantities of water. The loss by evaporation can be lessened and native plants can often be prevented from growing by cultivation.

The time to cultivate plowed prairie is, (1) as soon after plowing as it can be done without turning up sods, and (2) at such times thereafter as it may be needed to prevent the growth of grass and shrubs.

6—If once plowing does not kill the grass and small shrubs, backset after the sod has decayed

One of the functions of tilling prairie land is to kill the native vegetation. Another is to store moisture.

It has been pointed out that early breaking results in the storage of more moisture, but does not kill the grass as well as later breaking. To get a supply of moisture and at the same time kill the grass should be our aim.

This can be accomplished by early shallow breaking and by backsetting after the sod has rotted. The first plowing gives opportunity for the storing and conserving of more moisture, and the last kills any grass that lives after the first plowing.

Prairie land at Saskatoon that contained creeping rooted perennial grasses was broken and backset in 1911. On this land the yield of the second crop in 1913 was 14 bushels 36 pounds of wheat per acre. On adjoining land that had been broken deep and surface cultivated in 1911 the yield in 1913 was but 4 bushels 11 pounds per acre. The difference was due altogether to the presence of grass in the once plowed breaking.

Backsetting is not necessary where the native vegetation is such that it can be killed by once plowing early in the rainy season.

7—Don't backset if sod has not rotted

In very dry summers it is more difficult to backset than in wet summers, but it is less difficult to kill the prairie grasses. In the dry summer of 1914 in many places it was physically impossible to backset any breaking except that which had been done early and well packed down. In addition to this difficulty it was noticed that even where backsetting was done the unrotted sod produced a very unsuitable seed bed and one that required an unreasonable amount of surface

tillage before it was considered satisfactory. Fortunately backsetting is not so necessary in dry as in wet years.

8—Land intended to be backset should be broken shallow; that not to be backset, deeper

Deep breaking controls native plants better than shallow breaking, but under some conditions even the deeper work may not kill enough to make the practice profitable. Under these circumstances it is generally advisable in farm practice to plow shallow in the early part of the breaking season and deeper at the latter end. The early breaking can then be backset after the breaking season is over.

"Shallow" and "deep" as used here are relative terms. A depth of 2 to 4 inches is generally considered shallow and 4 to 6 inches deep breaking. "Backsetting" is done usually about 2 inches deeper than the "breaking."

9—Backsetting should be made firm and then harrowed

The moisture stored in the subsoil of breaking must be kept within easy access of the seed and plant roots. In order that this condition may obtain, firming the loose soil after backsetting is advisable. A subsurface packer is preferred for this work, but a surface packer, a disc or even the heavy harrows help to produce the desired condition.

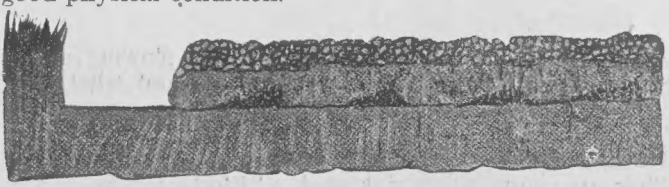
It is at the same time important that a shallow layer of loose soil be maintained on the surface of the field in order that the loss of moisture by evaporation may be lessened.

10—Scrub land must be treated somewhat differently

On land that carries a growth of bushes and small wood, backsetting is seldom practicable for the reason that the growth plowed under does not decay in time to permit it to be backset. Under these conditions very deep plowing followed by packing and thorough surface cultivation is the best procedure.

Early breaking on scrub land has many of the advantages of early breaking on prairie land, but because of the fact that most of our scrub land is in the more humid parts of our province, it is often difficult on early breaking to control the regrowth of native shrubs. It is fortunate that the conservation of moisture is often not as essential in these parts and the work may therefore be delayed.

At the same time it is well to keep in mind that the earlier the work is done the more moisture there will be conserved, and the earlier the rubbish is plowed under the quicker it will decay and leave the soil in good physical condition.



Sod land plowed on edge—note the air spaces under the furrow slice even when disced after plowing

FALL PLOWING

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1—The advantages to be derived from fall plowing are

(1) The killing of grass.
(2) The germination of weed seeds if done early.
(3) The covering of stubble.
(4) It forms a mulch.
(5) It is ready for seeding when spring opens up.

2—The disadvantages that sometimes result from fall plowing are

(1) Plowed soil is inclined to dry out.
(2) No stubble is left above ground to hold snow.
(3) Stubble plowed under often interferes with moisture.
(4) The effect of 2 and 3 is that lower yields often occur.
(5) It is sometimes difficult or impossible to plow.

3—If plowing is done in fall it should be done as early as possible

In the 1911 wheat crop at Saskatoon, early fall plowing increased the yield 1 bushel and 36 pounds over fall plowing done three weeks later. In 1913 the increase due to the earlier work was 1 bushel 10 pounds, while in 1914 it was 3 bushels and 4 pounds per acre.

4—If creeping rooted grasses or deep rooted perennial shrubs are present, deep plowing will control them best, but in the absence of these the plowing should be done to the depth at which the best job can be done

Plowing to control grass should be deep enough to get under the greater part of the root system. The deeper the plowing is the better it will control deep rooted weeds such as rose bushes and veined dock.

But deep fall plowing in dry autumns is often difficult and generally dries out. Under other conditions than the above, shallow plowing that is deep enough to cover all the rubbish and keep it from harrowing up on top is best, particularly if the land is fallowed every third year and plowed deeply at that time.

5—Harrow or firm the soil immediately after plowing on all except tight clay soils that bake, or on very grassy land where drying out of the furrow slice is desired

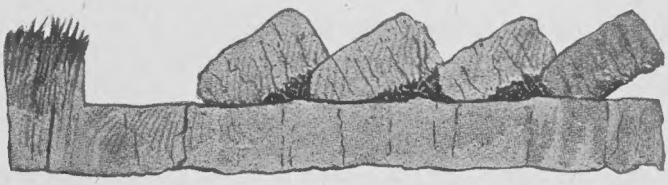
Harrowing after plowing should be regarded as an essential practice where moisture conservation is desired. Firming the soil is also necessary if it has been plowed more than 3 inches deep.

6—If the soil is packed immediately after the plow it should then be harrowed to establish a mulch

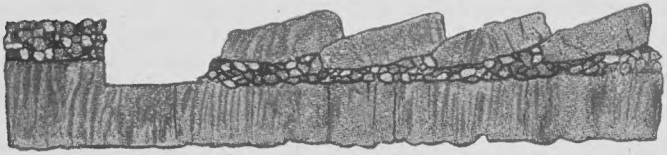
If a subsurface packer is used the harrowing may be dispensed with, but the harrow should follow all other packers unless the land is subject to blowing in which case very shallow plowing without either packing or harrowing may be desirable. In some cases surface cultivation with the disc is preferable to either.

7—On the few heavy clay soils that bake, fall plowing should be left loose in the fall.

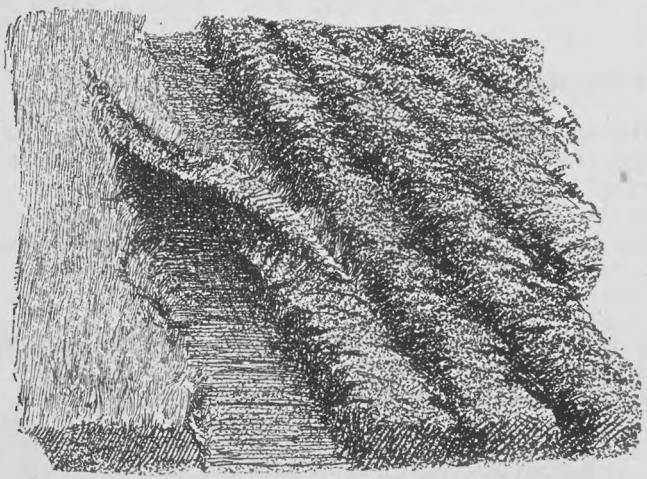
Otherwise the soil will run together in the spring and in some cases have to be plowed again. These however are abnormal soils and are found only in small areas in the province.



Placing the furrow on edge is desirable in humid regions and in fall plowing on soils that run together, but not on normal soils in dry areas. Here the furrow should be turned over flat.



Discing before plowing makes a desirable contact between the bottom of the furrow and the furrow slice.



The proper way to plow all dry land soils that do not run together and bake.

SPRING TREATMENT OF FALL PLOWED LAND

1—Drag harrow as soon as the land is dry enough to work

Harrowing at this time saves moisture by lessening evaporation. Every inch of moisture so saved means a possible increase of 2 to 4 bushels of wheat per acre. Aim to develop a *granular* mulch, not a dust mulch.

2—If creeping rooted grasses still persist, the land should either be plowed again and sown to oats or barley, or else summer-fallowed

Fall plowing aids in the control of these grasses, but does not always kill them. Sowing a second crop on grassy land is a sure way to get a crop failure.

3—See that the furrow slice is placed firmly in contact with the subsoil

This may have been accomplished by packing or discing in the fall. If not, as early as possible in the spring the land should be made firm by the use of the packer, or the plank drag, or the disc, or by several harrowings. It is essential that no large air spaces be left under the furrow slice, otherwise the soil will dry out and the crop "burn."

Harrow all packed land immediately after the packer, unless the seeders are following closely, in which case the harrow should follow the seeder. Firming the soil without loosening the surface immediately afterwards favors evaporation instead of retarding it.

4—Sow the seed into the moisture—not just to it

If the land is in good condition the moisture will be within 1 inch to 3 inches of the surface. If the soil is dry to a greater depth than 3 inches the field is not in the best condition and the right depth to sow cannot be accurately foretold.

Where possible use a press drill. This machine has many faults, but in dry areas it places the seed in the soil under more favorable conditions for growth than any other seeder. It sows the seed and then packs the soil over it.

If a single disc drill is used, it is sometimes advisable to pack after seeding.

If a double disc drill is used, packing is generally not so necessary.

After a press drill on firm, well prepared land, it is never advisable to pack.

If not packed before seeding, the land should be packed immediately after the drill and then harrowed—except after a press drill.

5—Sow thinly

Wheat, ¾ to 1¼ bushels; oats, 1¼ to 1¾ bushels; barley, 1 to 1½ bushels; and flax, 20 to 25 pounds per acre.

On light soils and those containing little moisture the smaller amounts may be used.

On heavy soils and those containing more water the larger quantities may be advisable.

N.B.—These rates are for second crop and not for fallow.

For areas North and East of Southwestern Saskatchewan and Southern Alberta, particularly where early fall frosts are more to be feared than dry weather—thicker seeding may be advisable.

6—Harrow the growing crop

Weeds use moisture and evaporation wastes moisture. Many weeds can be killed and much evaporation prevented by harrowing after the crop is up.

The best time to do it is when it will do the most good—that is when it will kill the most weeds or save the most moisture.

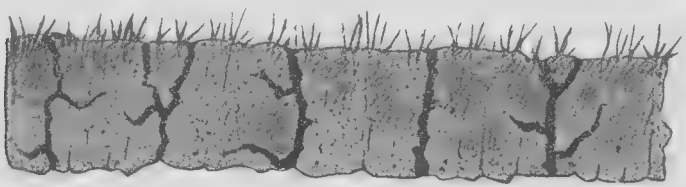
It will do the most good if done in warm dry weather when the weeds are small—just nicely out of the ground.

It will save the most moisture from evaporating if done before soils commence to get hard or crack. This generally happens sometime after heavy rains, but harrowing is often necessary even before any rains come.

If the ground is loose or rough or covered with stubble, harrowing will be attended with some disadvantages such as covering some plants and pulling out others. But looseness, roughness and stubble are things to guard against in the *preparation* of the land before seeding.

7—Don't expect a bumper crop on fall plowed land

It may come, but it may not. You will have done your part if—having done your fall plowing early—you use good seed and treat it with formalin, prepare a good seed bed early, keep the soil free from grass and weeds, loose on top and free from air pockets under the furrow slice.



Cracks in the land increase the evaporating surface many times over. This is a condition that should be prevented as far as possible by surface cultivation.

SPRING PLOWING

1—Plow as early as possible after danger of puddling and baking the soil is past

On the average, though it is not always the case, the earlier the plowing is done the larger the yield will be.

2—Plow to the depth at which you can do the best job

The depth to plow varies with the character of the soil, and the time and amount of the last rain preceding.

In general it is not necessary to plow deep in the spring for a crop the same year. But if the stubble is long, and particularly if there is grass in the land, deeper plowing is advisable.

3—Harrow immediately after the plow

Harrowing at this time aids in preventing the loss of moisture from the furrow slice. It also helps firm the soil.

A harrow section or small pulverizer attached to the plow or one drawn by an extra horse at the time the plowing is done is good practice.

Plowing should never be left unharrowed after the day it is done.

If it is possible to pack the land immediately after plowing, the harrowing may with profit be done after the packing. But it should be done *at once*.

Discing after spring plowing is seldom necessary on normal soils, but on lumpy soils or those inclined to bake or on land containing some grass it is often a necessary operation. If done, the harrow should follow as soon as possible after the disc.

4—Pack all spring plowing at the earliest opportunity after the operation

Loose open spaces under the furrow have caused more low yields on plowed land in dry regions than any other condition within our control. The furrow slice over an air space cannot help but dry out when the testing time comes. The subsurface packer under these conditions is to be preferred, but in its absence the surface packer should be used.

Where disc, shoe or hoe drills are to be used on soils that are in good condition, the packer may very well follow the seeder instead of preceding it.

If a press drill is to be used the packing will give best results if done before seeding.

The harrow should follow the packer if seeding is not to be done immediately, in which case harrowing after seeding is sufficient. Harrowing after a subsurface packer is generally advisable before seeding.

5—Sow as soon as possible after spring plowing is in condition

The sooner spring plowed land can be seeded the better the germination and the more even the stand will be.

6—Sow thinly

Wheat, ¾ to 1¼ bushels; oats, 1¼ to 1¾ bushels; barley, 1 to 1½ bushels; and flax, 20 to 25 pounds per acre.

On light soils and those containing little moisture the smaller amounts may be used.

On heavy soils and those containing more water the larger quantities may be advisable.

N.B.—These rates are for second crop and not for fallow.

For areas North and East of Southwestern Saskatchewan and Southern Alberta, particularly where early fall frosts are more to be feared than dry weather—thicker seeding may be advisable.

7—Harrow after seeding

This lessens evaporation, helps cover the seed and "finishes off" the field.

8—Harrow the growing crop

Weeds *use* moisture, and evaporating *wastes* moisture. Many weeds can be killed and much evaporation prevented by harrowing after the crop is up.

The best time to do it is when it will do the most good—that is when it will kill the most weeds or save the most moisture.

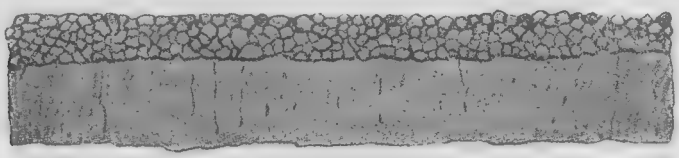
It will do the most good if done in warm dry weather when the weeds are small—just nicely out of the ground.

It will save the most moisture from evaporation if done before soils commence to get hard or crack. This generally happens sometime after heavy rains, but harrowing is often necessary even before any rains come.

If the ground is loose or rough or covered with stubble, harrowing will be attended with some disadvantages such as covering small plants and pulling up others. But looseness, roughness and stubble are things to guard against in the *preparation* of the land before seeding.

9—Don't expect a bumper crop on spring plowed land

It may come, but it may not. You will have done your part if you use good seed and treat it with formalin, prepare a good seed bed early, keep the soil free from grass and weeds, loose on top, and free from air pockets under the furrow slice.

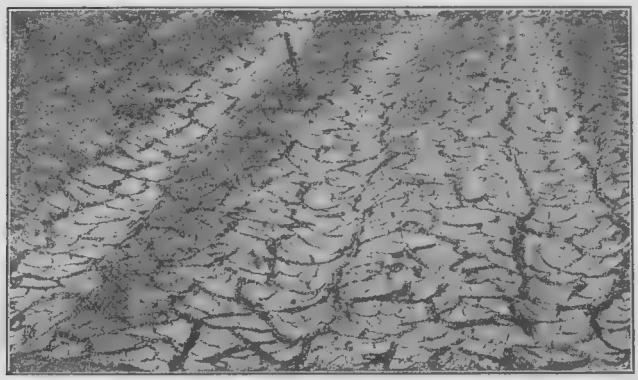


An effective granular mulch is the only practical means of lessening the evaporation of moisture (soil particles magnified 1000 diametres)

SPRING PLOWING

Poor Cultivation—This land was plowed when the ground was not in condition and a poor seed bed is the result. Seed will not only not germinate, but evaporation will be excessive.

A Well Prepared Seed Bed—The surface is loose to depth of planting. Subsoil makes good connection with furrow slice, thus capillarity is maintained from the subsoil to the roots of the plants.



Sun baked after heavy rains. Should be harrowed or otherwise cultivated at the **right time**—not too soon after rains nor yet too late.

NOTES ON BURNING STUBBLE AND "DISCING IN"

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1—Neither of these practices, nor both together, is ever sufficient preparation for "grassy land"

Perennial grasses must be killed if paying crops are to be grown. They can't be killed by burning off their tops or by discing up 3 or 4 inches of the surface soil.

2—Neither spring burning nor spring discing, nor both, is enough for weedy land

In regions where burning has been practiced for a number of years, weeds are the most serious present menace to the production of profitable crops.

The immediate disadvantage in spring burning is that no opportunity is presented to start weed seeds to germinate in the fall. As a result they remain on or in the soil to grow up with succeeding crops.

Early discing in the fall usually starts many weeds, but late fall discing starts few except in moist seasons, which in Saskatchewan are relatively few.

3—Discing fields carrying long stubble creates a nuisance on the surface of the land which interferes with proper seeding in the spring

Burning this stubble before discing may prove immediately profitable, but it is a permanently wasteful procedure.

4—Neither discing nor burning is satisfactory on soils that bake in the spring

On soils that do not come through the winter in a loose condition on top, a seed bed must be prepared. Plowing may not be essential to its preparation, but it is generally necessary.

5—Burning is sometimes a good practice for immediate returns

On rich dark soils that do not bake and are free from grass and weeds and carry a long stubble, burning and discing is often a profitable procedure for a few years. Under these conditions it may give larger immediate net returns than plowing. But note the conditions.

Discing—particularly if done early and thoroughly in the fall—is sometimes advisable on soils that (1) carry only a short stubble, (2) are free from grass, and (3) do not bake. If done thoroughly under these conditions, and the stubble taken from the harrows in windrows across the field and later removed or burned, fair returns are often secured. But note the conditions again—no grass, few weeds, short stubble, and soils that do not bake.

6—In general seeding on unplowed stubble is never good practice except on fields that have been thoroughly fallowed the second year previous and are free from perennial and biennial weeds

THE SUMMERFALLOW

1—The purpose of the fallow is to store and conserve in the soil a portion of one year's moisture for the use of the next year's crop

It is used incidentally to aid in the control of weeds.

2—Land to be summerfallowed should be cultivated the previous fall

The purpose of fall tillage is to conserve moisture and to start weed seeds.

If perennial grasses or weeds are present shallow plowing is advisable.

If only annual or biennial weeds are to be found thorough discing is sufficient.

Fall cultivation before fallowing increases the acre cost of production, but it pays.

3—Plow the fallow early in the rainy season

The purpose of early plowing is:—

(1) To put the soil in condition to absorb the heavy rains which usually come in June, (2) to prevent excessive growth of weeds and volunteer plants and thus conserve soil moisture, and (3) to permit the natural firming of the soil by rains rather than by the more costly method of packing.

In the driest year ever experienced at Saskatoon, a fallow was plowed at two different times. That plowed June 1st yielded 10 bushels 24 pounds more wheat and 11 bushels 30 pounds more oats than that plowed July 1st.

Neither of these plots was cultivated in the fall before the fallow. Had they been plowed or even thoroughly disced in the fall, the later plowing would probably have given much more favorable returns.

4—Plow fallow deeply

Deep plowing increases the water holding capacity of the soil and aids in the control of perennial weeds and grasses. It is very necessary on soils that develop a hard pan.

The good effect of deep plowing shows more in the second crop after the fallow than in the first.

On shallow soil a depth of 7 inches should be obtained gradually and not necessarily at the time of the first fallow.

5—Harrow immediately after plowing

The moisture in the furrow slice escapes quickly after plowing. *Immediate* harrowing will prevent a large percentage of this loss.

At Saskatoon harrowing immediately after the plow has resulted in an average increase of approximately 2 bushels of wheat per acre.

Harrowing should be done immediately after plowing or in any case not later than the evening of the day the plowing is done.

6—Keep down the weeds

Our common weeds dissipate about a quarter of a ton of water for every pound of dry matter they produce.

It is very necessary to cause the germination of weed seeds that are in the soil, but it is essential that all weeds be killed as soon as possible after they start to grow.

They can be killed easiest and cheapest when they are small. At this time harrowing will kill millions of them very cheaply. If they are permitted to grow more, the disc or cultivator may have to be used, while if allowed to grow still more, plowing only will control them.

7—Control evaporation by maintaining a soil mulch

Water evaporates into the air at or near the surface of the soil. It rises very slowly through a loose soil and much more slowly through a dry soil.

By taking advantage of these facts we can control evaporation by keeping a loose dry layer two or three inches deep on the surface of the soil.

This loose dry layer can be put on and maintained by cultivation at intervals during the summer, particularly after heavy rains. Use the harrow or disc or cultivator or all three according to the conditions to be overcome.

Try to avoid a dust mulch—a granular one will blow less and can be obtained by less frequent use of the harrows and more frequent use of the cultivator.

8—The fallow on most normal soils is ready to sow after harrowing in the spring

But fallows that have been pastured heavily often need fall or spring discing, preferably the former.

Heavy soils that run together in the spring generally need to be disced or cultivated. The surface of such soils should be left rough in the fall.

The fallowing should be harrowed as early as possible in the spring and again immediately after seeding, particularly on soils which do not blow.

Hard soils resulting from either baking or tramping should receive such cultivation with harrow or disk as will prepare a favorable seed bed.

9—Rates of seeding for summerfallow

Wheat, 1 to 1¾ bushels; Oats, 1½ to 2½ bushels; Barley, 1¼ to 2 bushels and Flax 25 to 35 pounds per acre.

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